ACTIONABLE INTELLIGENCE

LINK MONITORING—NICE TO HAVE, OR, MISSION CRITICAL?

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Persistence, on-demand, real-time Intelligence, Surveillance, and Reconnaissance (ISR) and the ability to deliver weapons without putting an aircrew at risk, are what typically come to mind when the subject of Unmanned Aircraft Systems (UAS) is discussed. This mindset is reinforced by operational successes in Iraq and Afghanistan as well as in non-combat and domestic applications, such as border security and disaster response missions (i.e., monitoring forest fires and assessing flood damage). Unless you are a communications specialist, or frequency manager, rarely do conversations gravitate toward the importance of the communications links that make UAS operations possible.

UAS's are heavily dependent on line-of-sight and beyond-line-of-sight communications for command and control and relay of mission data. For medium and high altitude UAS's, satellite communications are essential for maintaining connectivity. The fact that data links are susceptible to Radio Frequency Interference (RFI) is nothing new. However, when combined with the dynamics of the current UAS environment, the ability to detect and negate RFI may increase in importance and drive changes in how these systems are operated. At SAT Corporation, providers of RF Monitoring and Interference Detection Systems, the belief is that link monitoring for Unmanned Aircraft Systems is no longer a "nice to have"—they are now "mission critical".

The DoD Unmanned Systems Roadmap confirms this assessment…"*In general, there are two main areas of concern when considering link security: inadvertent or hostile interference of the uplink and downlink. The forward ('up') link controls the activities of the platform itself and the payload hardware. This command and control link requires a sufficient degree of security to ensure that only authorized agents have access to the control mechanisms of the platform. The return ('down') link transmits critical data from the platform payload to the warfighter or analyst on the ground or in the air. System health and status information must also be delivered to the GCS or UAS operator without compromise. Effective frequency spectrum allocation and management are key to reducing inadvertent interference of the data links.*"

The Unmanned Systems Roadmap also provides an excellent synopsis of the current environment "...*spectrum availability is becoming increasingly unavailable or shared, whether in the Continental United States (CONUS) or in overseas theaters. Many UAS types, from Global Hawk to Scan Eagle, have lost at least one aircraft to frequency interference or misuse.*"

This is compounded by the rapid growth in UAS systems that will drive demand for new capabilities and procedures to safely manage, coordinate, and operate the many systems currently in testing, or planned for deployment, in the near future. In addition to the Air Force, Army and Navy, NOAA, NASA, the Air National Guard, U.S. Forest Service, Customs and Border Patrol, the U.S. Coast Guard, and other national agencies, all are currently operating, or plan to operate, medium to high altitude UAS's. The next logical course of action becomes one of safe deployment and operations, and to identify the tools available to minimize RF Interference.

Currently operational testing and development of UAS systems is conducted on the national test ranges and is essential for maintaining and enhancing current systems as well as pushing technology forward. To operate UAS's solely within the National Airspace System (NAS) requires FAA approval. Such is granted on a case-by-case basis and approved tail numbers are small in number. One reason for this is that the policy and procedures for UAS lost link procedures and NAS flight rules are still being worked out.

Policy and politics aside, there are systems in operations today that can help improve link monitoring for UAS operations. SAT Corporation's Monics Carrier Monitoring and Interference Detection System is one tool that can assist operators in monitoring satellite data links to identify interference and take corrective action before mission impact.

Carrier monitoring combined with on-board sense and avoid technologies being developed by other entities

offers to contribute to the resolution of NAS flight issues, specifically the ability to maintain positive control and safety of flight.

SAT's Monics systems are widely used in the satellite communications industry to ensure quality of service. The system uses digital signal-processing technology to automatically monitor all uplink and downlink carriers on a satellite. The automatic process provides immediate alerts when a carrier problem arises (such as interference), allowing the operator to take corrective action and or switch to an alternate link.

Digital Spectrum Analyzers (**DSA**) can find interference occurrences within live carriers before the interference becomes a real issue. DSAs can locate interference under the entire live carrier bandwidth and analyze it. With knowledge that interference is occurring, and having access to the analysis of the interference, the operator can work to remove the obstruction.

This same system can be used without modification to monitor satellite links used for UAS operations. Therefore, this really is a COTS mission assurance tool available today and one that can be deployed to any ground station using SATCOM links for UAS command and control.

The other aspect of UAS data link monitoring is to address the potential for line-of-sight interference.

SAT SigMon systems offer another tool to address the potential for UAS line-of-sight interference. Currently deployed on a number of DoD Test Ranges, SigMon is a terrestrial RF monitoring, interference detection, and geolocation system designed to detect and locate terrestrial signals of interest. SigMon

provides the user automated measurement, recording, analysis, and playback of signals of interest, as well as automated report generation. The system is scalable and can be deployed in a moving vehicle, at fixed locations, or a in a configuration of both mobile and fixed assets.

Just as with Monics, SigMon is a COTS solution that can be used to support UAS operations with little or no modification to the standard configuration. The notional concept of employment for both SAT Monics and SigMon systems to support UAS missions is shown in *Figure 1*.

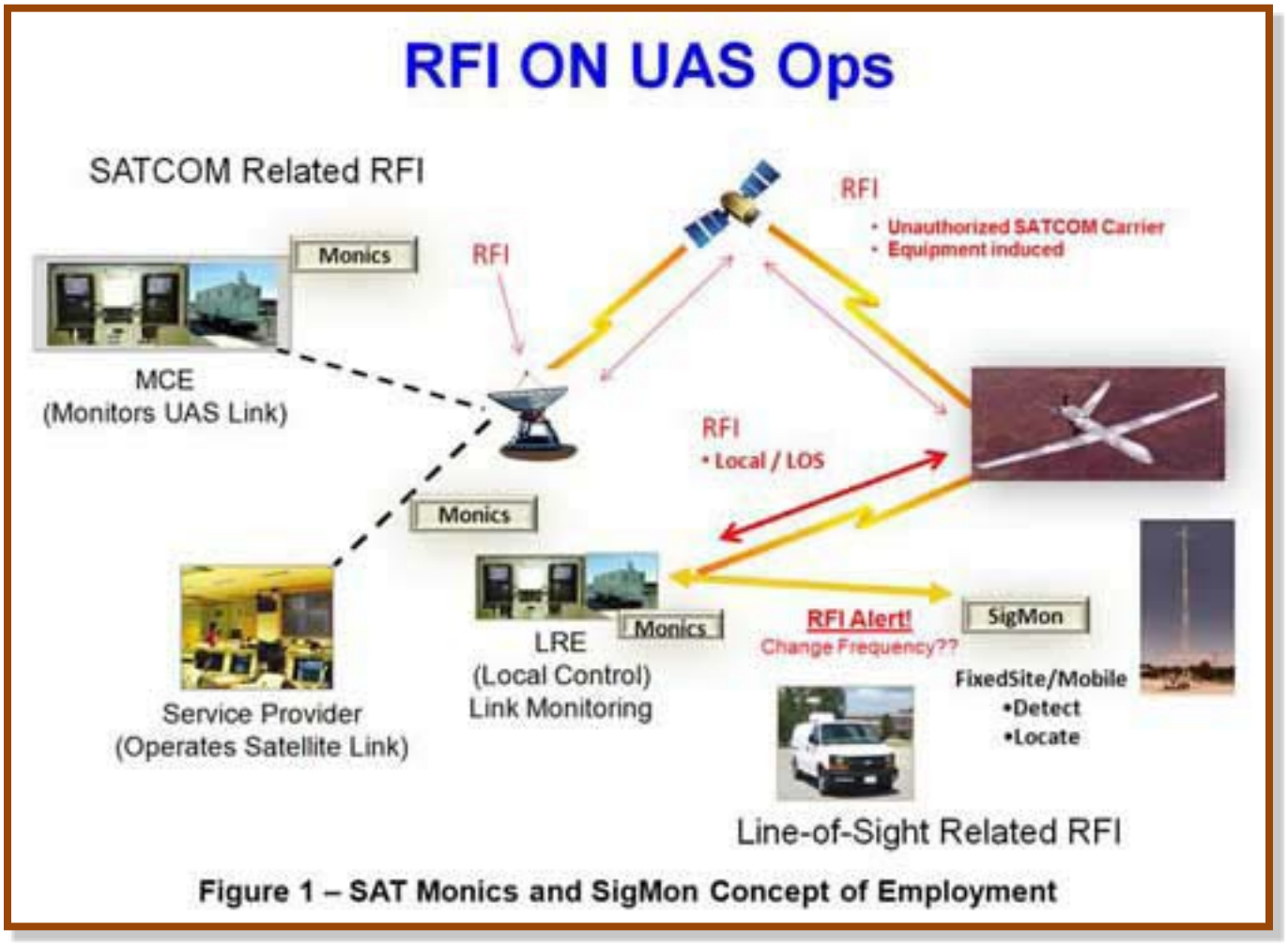

Figure 1 – SAT Monics and SigMon Concept of Employment

Another aspect of the UAS scenario and RFI is the use of frequency management and planning tools to aid in reducing "accidental" interference events. Although there are a number of standalone frequencies, spectrum planning, and UAS mission planning tools available, modifications that could correlate a UAS mission and frequency plan with the actual RF environment would be beneficial. SAT Corporation is actively looking at ways to add functionally to UAS mission planning software by automatically correlating real-time satellite link and line-of-sight data against scheduled events or missions. In one scenario, a SigMon operator could highlight, or mouse-over, the spectral trace and the corresponding mission information and allocated spectrum would be displayed on the screen (*Figure 2*). Mission assignments could then be used to automatically mask known or scheduled signals in the mission-monitoring plan. Anything radiating after the mask is filtered out as potential RFI, which can then be located and eliminated (*Figure 3*). Not only will this help ensure compliance with the approved frequency plan, SAT monitoring plans can run continuously to detect and catalogue intermittent signals that are difficult to detect and eliminate.

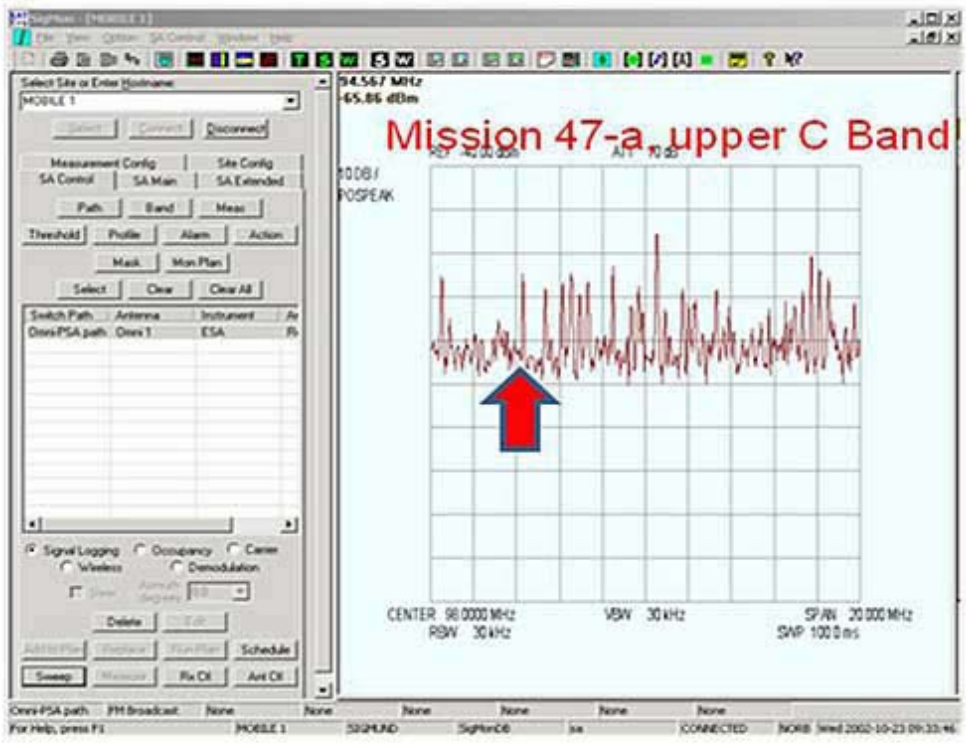

Figure 2 – SigMon Spectral trace with Mission Highlight

SAT Monics and SigMon systems deployed individually, or as a system (depending on the UAS configuration), offer a cost effective link monitoring capability. This applies to ranges conducting UAS operations and could be expanded to include UAS operators overseas supporting theater operations or conducting operations in the NAS to provide pre-mission RF band clearing, real-time line-of-sight monitoring during mission operations, and for post mission analysis.

For the near term, we see the need for UAS data-link monitoring to continue to grow more as more systems are put into operation. Ideally, we would like to see a monitoring system associated with every UAS operations node, and satellite link monitoring systems at every ground station controlling medium and high altitude UAS's. Ultimately, over the long term, program requirements either from the FAA or DoD that define requirements for UAS link monitoring or requirements for onboard sensors that will automatically detect interference and switch to a clear backup channel may be required to standardize or baseline UAS operations.

MSM

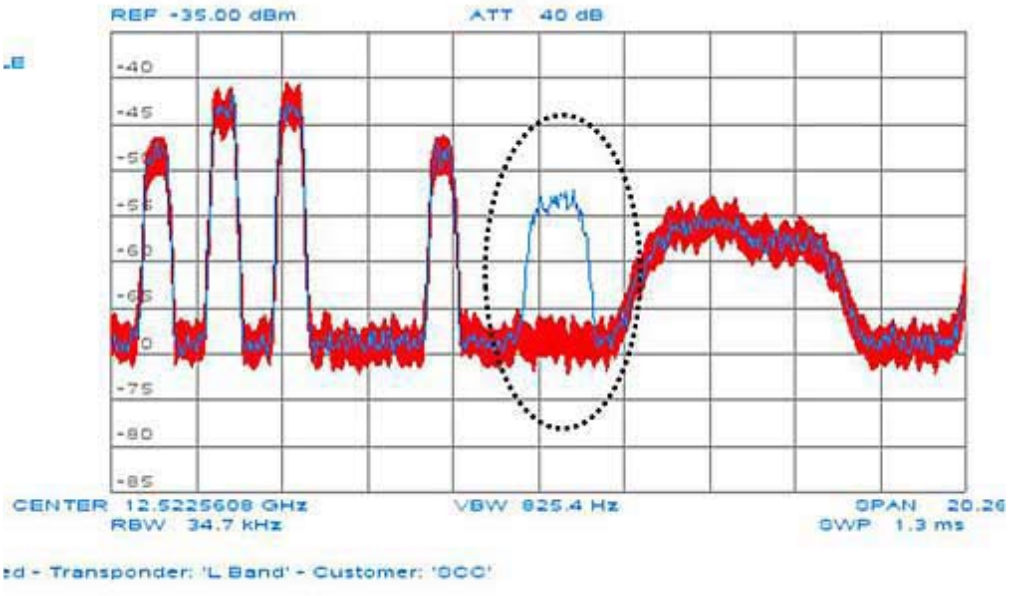

Figure 3 – Suspect Signal

About the author

Scott Herrick is the Director of Government Business Development for SAT Corporation. One of his primary functions is to identify new Government market areas and applications for the Company. Prior to joining SAT Corporation, he served for more than 20 years as an Air Force Officer in various Space and Command and Control assignments.